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# Analysis of Smoking Patterns and Contexts Among College Student Smokers

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## Analysis of smoking patterns and contexts among college student smokers

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### Abstract

Many who smoke in college do so infrequently and smoking conditions are not well-understood. We examined smoking patterns among college fraternity and sorority members (N=207) from a Midwestern university in three successive fall semesters in 2006–2008. Participants completed calendar-assisted retrospective assessments of 30-day smoking at up to 5 assessment points over 96 days. Overall smoking rates declined over the course of each semester and higher smoking on weekends was observed, with more variability among daily smokers. The most frequent categories of events to cue recall of smoking were socializing, work, and school. Findings can be used to target prevention efforts.

### Keywords

smoking; college students; patterns; Timeline Follow-Back; non-daily smoking; daily smoking

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Reducing cigarette smoking in the young adult population is a national health priority. The smoking rate among this group has not declined as it has among other age groups in the US (Lantz, 2003), with nearly 30% smoking in the past 30 days (Johnston, O'Malley, Bachman, & Schulenberg, 2007; Rigotti, Lee, & Wechsler, 2000). Since 19 million adults are enrolled in US colleges and universities (U.S. Bureau of the Census, 2009), college students comprise a sizeable group of smokers. Studies characterize college as a time of smoking transitions including smoking initiation (Wetter et al., 2004) and most students do not smoke every day (Fiore et al., 1993; Waters, Harris, Hall, Nazir, & Waigandt, 2006). Longitudinal studies show that 50% of students who smoke occasionally and 87% who smoke daily at baseline assessments continue smoking throughout college (Wetter et al., 2004) and many continue after graduation (Everett et al., 1999). These findings highlight the importance of addressing smoking behaviors among college students.

Many college smokers do so infrequently and primarily in social contexts. Moran and colleagues (2004) found that over half of students surveyed from US colleges reported that they smoked primarily with others. Social smoking was also significantly associated with recent initiation of smoking behavior (i.e. within past 2 years), past 2-week self-reported binge drinking, and frequency of socializing (i.e. greater than 2 hours per day). Similarly, Waters and colleagues (2006) found that in a sample of college students who reported smoking on at least one out of the past 30 days, over 70% were characterized as social

smokers, having endorsed “partying or socializing” as the most common activity while smoking. Studies employing real-time self-assessment of smoking behaviors among college students have also shown that smoking frequently occurs in the context of alcohol consumption (Cronk & Piasecki, 2010; Krukowski, Solomon & Naud, 2005). Collectively, these studies suggest that socializing and consumption of alcohol are important correlates of smoking among college students, particularly those who smoke less than daily.

Little is known, however, about the specific weekly, monthly or semester-long patterns of smoking in relation to social and drinking events among college students. In a study of the patterns of smoking in college freshmen, Colder and colleagues (2006) used weekly on-line diaries and found that smoking rates were higher on weekend days (i.e. Friday and Saturday) relative to weekdays (i.e. Sunday through Wednesday), and that smoking rates were at their highest at the beginning of the academic year and declined throughout the semester. Additionally, smoking rates were higher when school was in session than during breaks (e.g. Spring break), and on weekends designated by students as “party weekends” (e.g. Halloween weekend) versus other weekends. Despite substantial individual variability among smokers in this study, these results suggest that smoking among college students is linked to discernable patterns in the academic and social calendar of students.

Whereas the study by Colder and colleagues provides important insights into the patterns of smoking among first year college students, upperclassmen were not included in this sample. One might expect to see different patterns of smoking among students in different academic levels. Additionally, it is unclear to what extent patterns in smoking may be differentiated across levels of smoking. For instance, it may be reasonable to hypothesize that smoking among daily smokers, who may be further along the path to dependence would be less influenced by day of the week or time of year. Alternatively, individuals who smoke less frequently may be under stronger stimulus control and therefore more likely to be influenced by factors such as “party weekends.”

The purpose of the present study was to assess the weekly and semester-long smoking trends among a sample of college student smokers from all academic levels. We sought to examine whether these trends were different for individuals with varying rates of smoking reported at the beginning of the semester. Additionally, we sought to investigate the frequency with which various situations or events were linked to smoking.

## **Method**

### **Participants**

The present study was part of a larger clinical trial of a behavioral intervention to promote smoking cessation among college student smokers, which has been described elsewhere (Harris, Catley, Good, Cronk, Harrar, & Williams, 2010). Students enrolled at a large Midwestern university who were members of social fraternities and sororities were recruited to participate in a health program (Davidson, Cronk, Harris, Harrar, Catley & Good, 2010). Participants were approached during a weekly meeting of their chapter and invited to participate voluntarily. This research was monitored and approved by Institutional Review Boards at The University of Montana and University of Missouri. The treatment arm of this study included a motivational intervention to increase smoking cessation. Inclusion criteria for the study included a minimum of 18 years of age, having smoked at least one cigarette in the past 30 days, and no use of medications to assist in smoking cessation within the past 30 days. Only the 207 participants in each of three cohorts (Time 1 N = 80; Time 2 N = 61; Time 3 N = 66) assigned to the comparison arm, which was focused on increasing the consumption of fruits and vegetables, are included in the present analyses.

## Procedure

Brief screening assessments were administered to potential participants at chapter meetings at the beginning of the fall semester in order to determine eligibility for the study. Eligible individuals were invited to complete a computerized baseline assessment battery within 1–2 weeks of the screening date. Following this assessment, chapters were randomized to the comparison condition and participants were scheduled to complete the first of four counseling sessions. These were one-on-one sessions with a study counselor focused on increasing the consumption of fruits and vegetables. Participants completed the first three counseling sessions approximately every other week with the fourth session occurring approximately four weeks after the third session.

## Measures

**Timeline Follow-Back**—At each of the five assessment time points (baseline and sessions 1–4) participants completed the Timeline Follow-Back (Harris, Golbeck, Cronk, Catley, Conway, Williams, 2009; Sobell & Sobell, 1996) assessment of smoking covering up to the past 30-days. The Timeline Follow-Back (TLFB) is a calendar-assisted assessment in which participants were presented first with a computer-displayed calendar populated with school-related events, such as the first day of classes and football games. Participants were prompted to enter anchoring events that were personally salient (e.g. “party at Erin’s house”). Participants were free to enter as few or as many events as they wished. These events were then incorporated into the pre-populated calendar and displayed on a computer screen to participants who were then asked to report how many cigarettes they smoked on each calendar day. The TLFB has shown good test-retest reliability as well as correlations with alternative smoking measures (Brown, Burgess, Sales, Whiteley, Evans, & Miller, 1998; Gariti, Alterman, Ehrman, & Pettinati, 1998; Harris, et al., 2009; Lewis-Esquier, Colby, Tevyaw, Eaton, Kahler, & Monti, 2005). In cases where the last contact was within this 30 day window, the assessment covered the day following the last assessment point until the day of the current assessment, resulting in a total period covering 96 continuous days. All information was entered by participants directly into computers.

## Statistical Analyses

Participants were divided into three groups based on the number of days out of the past 30 on which they reported smoking at the baseline assessment. Smoking categories included infrequent (0–5 days; N=87), moderate (6–29 days; N=90) and daily (30 days; N=30) smoking. Time series methods were used to assess the trends and periodicity in daily smoking rates in the three groups. We estimated the trend using a 7-point centered moving average to explore the possible 7 day trends. Once the trends were estimated and analyzed, we subtracted them from the data to assess the periodic behavior via periodogram (Shumway & Stoffer, 2006). Examination of the periodogram allows for the identification of the number and strength of cycles of smoking frequency in the data.

## Qualitative Analyses

Anchoring events entered by participants at baseline in the TLFB calendar were examined and classified into naturally occurring groups using a grounded theory approach (Corbin & Strauss, 2008). This approach entails examining data and deriving related concepts to form meaningful categories. The coding scheme was constructed using the entire sample of events. Nearly all responses (93.5%) were classified by the following 13 categories: Drinking (explicitly stated), Party, Chapter Events, Work, School, Moving, Other Socializing (non-party), Eating, Vacation, Family, Relax/Daily Living, Sports/Exercise, and Concert/Event. Table 2 includes definitions and sample responses that comprised each category. Following creation of the coding scheme, a random sample of 10% of responses

( $N=572$ ) were selected and coded. Some responses were characterized by more than one event and in these cases each event was categorized separately, resulting in a total of 659 events subjected to coding. A random subset of 10% of these responses was coded by a second rater to assess for inter-rater reliability. Overall agreement was 90.6% (58/64), which Cohen's Kappa (Cohen, 1960) shows is significantly higher than expected by chance ( $kappa = .89$ ) and represents almost perfect agreement (Landis & Koch, 1997).

## Results

### Demographics

Baseline characteristics of the sample are depicted in Table 1. The sample described here was primarily white (94%), consisted of slightly more women (56%) than men and was comprised of more underclassmen (56% self-identified freshmen or sophomores) than upperclassmen with a mean age of 19.5 ( $SD = 1.01$ ). This sample was comprised mostly of non-daily smokers (85.5%), with a large proportion of infrequent smokers (42%). The number of anchoring events entered into the TLFB calendar ranged from 0 to 78 ( $M = 14.91$ ;  $SD = 13.77$ ).

### Weekly Smoking Trends

As predicted, more cigarettes were smoked on weekends relative to weekdays. The mean number of cigarettes smoked on Fridays (121.8) and Saturdays (132.1) were not quite twice the average number smoked on Sundays (72.8) and Mondays (77.0) (see Figure 1). As shown in Figure 1, compared to infrequent and moderate smokers, daily smokers showed substantial variation in daily smoking rates. Examination of the periodograms (not shown) confirmed a periodic pattern of smoking that cycled over a 7-day period for moderate and daily smokers only. The time plots gave a clear indication of a 7-day cycle with a steady increase in smoking from Sunday to Sunday with a small slack in the middle of the week, particularly for daily smokers. Since there was little variation to explain among infrequent smokers, a noticeable peak in the periodogram was not observed for this group.

### Semester Smoking Trends

Figure 2 displays the average number of cigarettes smoked over the course of the Fall semesters. There was an overall downward trend in smoking rates across the course of the semester. A downward linear trend was exhibited among infrequent smokers, although it is not visible due to the very small variation in smoking rates within this group. Daily smoking rates for moderate smokers exhibited a clear downward linear trend. On the other hand, the trend for daily smokers was not quite linear. In fact, an increasing trend was evident in the period right before school began with relatively high rates of smoking in the beginning of the semester. Thereafter, a steady downward trend continued until later in the semester, when the trend exhibited an upturn.

### Contextual Events

Qualitative analyses revealed that one-third (33.2%) of the anchoring events reported on the TLFB were classified as drinking, party or other socializing events (see Figure 3). Figure 3 also shows that work and school characterized an additional 22.6% of events. The least frequent events reported by participants included eating (1.7%) and spending time with family (0.8%).

## Discussion

The goals of this study were to assess the weekly and semester-long patterns of smoking among college students who reported varying rates of smoking. In addition, we sought to describe the relative frequency of situations and events linked to student smoking.

### Semester Smoking Trends

Consistent with the findings of Colder and colleagues (2006), we found an overall downward trend in smoking across the course of the semester. This trend was most pronounced among the moderate smokers. Interestingly, there was an initial peak in smoking rates at the beginning of the semester among the daily smokers that then dissipated over the course of the semester. This may reflect a pattern of reactivity as students arrive on campus, free from any parental monitoring that may have accompanied the summer break. Because daily smokers smoke at higher rates, to the extent that there was suppression of smoking during the summer break, this peak at the start of the semester may represent a rebound effect of sorts. It is unclear whether the overall downward trend was due to increased academic pressures, fewer social activities, colder weather or a combination of these factors that may have all coincided with progression of the semester. These findings regarding the patterns of smoking among relatively infrequent college student smokers provide a unique contribution to the literature.

### Weekly Smoking Trends

Consistent with other studies of college student smokers, our results also indicated that smoking rates were higher on weekends relative to weekdays. There was a steady increase in the mean number of cigarettes smoked from Sunday through Saturday in this sample. Previous research has suggested that weekend smoking among college students may be related to the increased frequency of social events and parties on weekends (Colder et al., 2006). Whereas, the present study did not directly assess the association of social events with number of cigarettes smoked, it was clear from the qualitative analyses that students reported a high frequency of both drinking and parties when reporting their smoking. Additionally, the present sample includes college students with relatively high rates of drinking behavior (analyses not shown; Harris et al., 2010). The weekly cycle of smoking in this sample may reflect smoking in the presence of parties and alcohol consumption. These results provide valuable insight into the patterns of smoking among relatively infrequent smoking college students involved in social fraternities and sororities.

Perhaps surprisingly, the weekly trend was more pronounced among daily smokers relative to non-daily smokers. Prior research suggests that social smokers tend to smoke fewer cigarettes and on fewer days than non-social smokers (e.g. Moran et al., 2004; Waters et al., 2006). One explanation for the finding of a stronger weekly pattern among daily smokers in this sample may be the relative lack of variance in smoking rates among the infrequent smokers in this sample. This interpretation is supported by increased rate of smoking on Fridays and Saturdays relative to other weekdays among students in this group. Nevertheless, the findings suggest that triggering situations/events still play an important role in influencing the smoking frequency for daily smokers. This is potentially important in interventions for college students as it suggests interventions that target common smoking situations/events are likely to influence smokers of all smoking levels.

In summary, there exists a long term change in the daily smoking rate over the period of the semester. This change appears to follow a downward linear trend in the moderate smokers whereas the trend changes over time for daily smokers. Not much can be said for infrequent smoker as the smoking rate and variation is relatively small. For all three groups there is a 7-

day smoking cycle where smoking rates are lower in the beginning of the week and incrementally increase into the weekend.

### **Contextual Events**

To our knowledge, no previous studies of this population have examined the anchoring events that students use to cue recall of their smoking behavior. These anchoring events provide valuable insight into the salient event categories students use to cue recall of smoking behavior, which may prove useful in targeting prevention and intervention efforts. When asked to provide cuing events prior to recalling information about cigarettes smoked, students in this college sample reported primarily drinking and party events. This finding is consistent with prior studies that have demonstrated a link between partying and socializing and smoking behavior (e.g. Cronk et al., 2010; Waters et al., 2006). An alternative explanation may be the high rate of partying and socializing that is characteristic of this population. In addition to these social events, students in this sample listed work and work-related events as the second most frequent category. This may be one means by which students mentally structure their days as well as the contexts in which they recall smoking events and work breaks may represent smoking opportunities.

### **Implications**

The results of this study suggest that smoking rates are higher in this population at the beginning of the semester, with a gradual decline as the semester progresses. This trend along with the finding that smoking rates are higher on weekends relative to weekdays, suggests that efforts to dissuade college students from initiating or continuing to smoke are likely to have the greatest opportunity for impact if targeted to occur early in the semester and on weekends.

To the extent that college students associate smoking with drinking and partying events, smoking interventions targeting the contexts in which these events occur may have maximal impact on smoking behavior. Our results suggest that when asked to provide salient events to aid recall of smoking behaviors, college students frequently reference partying, drinking or other socializing events. This suggests that smoking interventions targeting co-occurring smoking and socializing may have maximal impact.

Our results also suggest that students may mentally construct their semesters in terms of work and school related responsibilities. Given that these events may be particularly salient to students, smoking intervention and prevention efforts aimed at linking smoking with work and school responsibilities may be particularly relevant to college students.

### **Limitations**

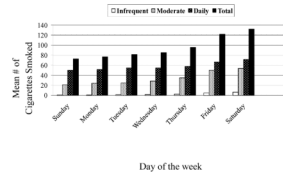
These analyses were conducted with a sample of college students enrolled in Greek social organizations (i.e. sororities and fraternities) and therefore may not be representative of all college student smokers. Similarly, this sample was comprised of predominantly white, psychologically healthy students with high academic achievement, limiting generalizability to other college student samples. The lack of direct tests of the association of smoking in the presence of parties and alcohol consumption limits the strength of conclusions that can be drawn in this regard. However, a strength of this sample is the inclusion of light smokers, about whom information is limited. We were able to identify the weekly and semester trends of smoking among this group, which is a new addition to the literature. Further, the descriptive analysis of the anchoring events entered by students into the calendar-assisted smoking recall assessment represents a new and informative addition to the literature on college student smoking contexts.



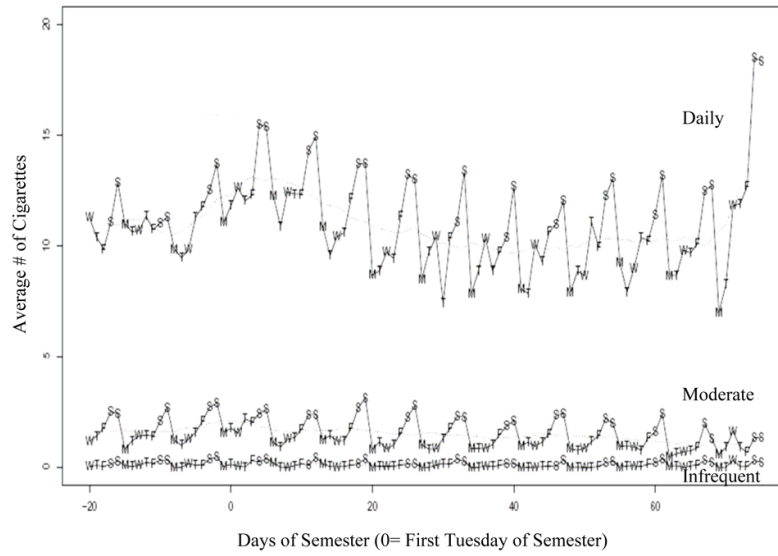
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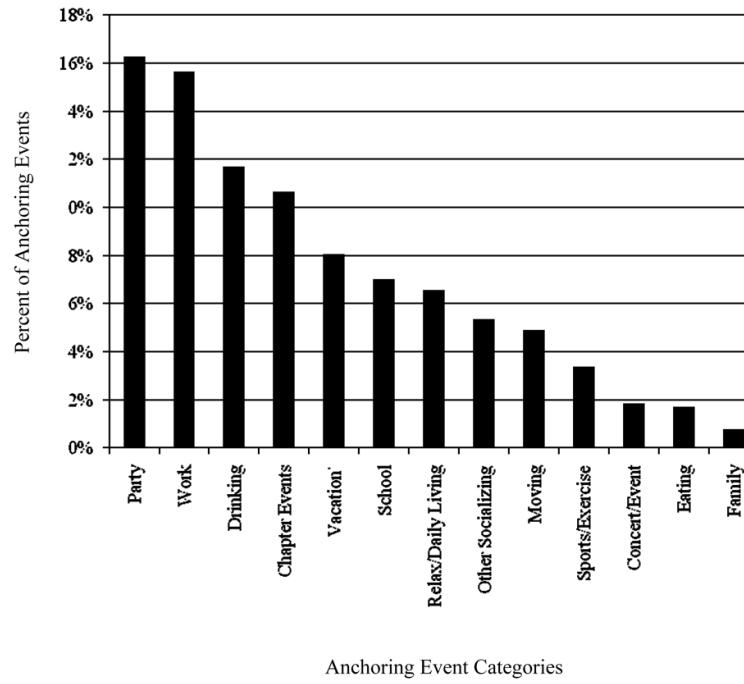
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**Figure 1.**  
Mean Number of Cigarettes Smoked on Each Day of the Week



**Figure 2.** Time Plot of Average Number of Cigarettes Smoked Over a Semester by Smoking Level. Note. “W T F S S M T” represent days of the week beginning with Wednesday; “-20” on the x- axis corresponds to 20 days prior to the first day of the semester



**Figure 3.** Categories of Anchoring Events Listed at Baseline Timeline Follow-Back Assessment

**Table 1**

## TLFB Response Categories

<b>Category</b>	<b>Definitions</b>	<b>Sample Responses</b>
<b>Drinking</b>	Any event that explicitly referred to drinking alcohol or going to a bar/club where alcohol is served.	“got drunk,” “went to [bar]”
<b>Party</b>	Any party event with no explicit reference to alcohol.	“party,” “birthday party”
<b>Chapter Events</b>	Any gatherings, activities or events that are explicitly related to participation in a sorority/fraternity.	“rush,” “bid day”
<b>Work</b>	Any reference to going to work, applying of work or activities explicitly stated as part of work.	“work,” “last day of work,”
<b>School</b>	Any events related to attendance at school or academic work/homework.	“school,” “classes,”
<b>Moving</b>	Any reference to preparing to move, moving or completing the moving process (i.e., unpacking).	“moved into apartment,” “packing”
<b>Other Socializing</b>	Any activity involving other people that does not include party, sports/exercise, or explicit reference to alcohol.	“hung out with [name],” “had friends over”
<b>Eating</b>	Any reference to a meal or eating.	“dinner w/ [name],” “BBQ at [place]”
<b>Vacation</b>	Any reference to a specific location, other than home or school, or explicit mention of vacation.	“[city name],” “vacation”
<b>Family</b>	Any reference to being with individual(s) explicitly identified as family members.	“family,” “dealing with parents”
<b>Relax/Daily Living</b>	Any day-to-day activities that do not fall in other categories listed here.	“regular errands,” “relaxed”
<b>Sports/Exercise</b>	Any activity involving physical exertion or participating in a sporting event.	“golfing,” “worked out”
<b>Concert/Event</b>	Any music or special venue event or professional or amateur sporting event attended as a spectator.	“[name] concert,” “[NFL team] game”

**Table 2**

## Baseline sample characteristics (N=207)

<b>Gender</b>	<b>N</b>	<b>Percent</b>	<b>M</b>	<b>(SD)</b>
Female	117	56.5		
Male	90	43.5		
<b>Race</b>				
White	194	93.7		
Asian	4	1.9		
Biracial/Multiracial	4	1.9		
Other	5	2.4		
<b>Ethnicity</b>				
Hispanic/Latino	4	1.9		
Non-Hispanic/Latino	190	91.8		
<b>Age</b>			19.5	(1.02)
<b>Year in School</b>				
Freshman	38	18.4		
Sophomore	79	38.2		
Junior	56	27.1		
Senior	32	15.5		
<b>Average Grades to Date</b>				
A's	72	34.8		
B's	111	53.5		
C's	24	11.5		
<b>Alcohol Use Last 30 days</b>				
≤ 5	21	10.1		
6–9	53	25.6		
10–19	103	49.8		
≥20	30	14.5		
<b>Smoking Level (Days<sup>a</sup>)</b>				
Infrequent (0–5)	87	42.0		
Moderate (6–29)	90	43.5		
Daily (30)	30	14.5		

Note.

<sup>a</sup>Number of days smoked out of the past 30 days